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NATIONAL MARINE FISHERIES SERVICE

June 1991

ANNUAL REPORT OF THE 1990 WESTERN PACIFIC LOBSTER FISHERY

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National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96822-2396

with contributions from

Southwest Region
Pacific Area Office
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Southwest Enforcement
National Marine Fisheries Service, NOAA
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Western Pacific Regional Fishery Management Council
Honolulu, Hawaii 96813

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ADMINISTRATIVE REPORT H-91-06

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Southwest Fisheries Science Center
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Errata

Administrative report H-91-06, page 19, Table 9: "Net revenue ($) **91,861**" should read "Net revenue ($) **-91,861.**"

June 1991

NOT A PUBLICATION

PREFACE

The western Pacific lobster fishery is in its eighth season under the Crustacean Fishery Management Plan (FMP) which was enacted by the Western Pacific Regional Fishery Management Council (WPRFMC) in 1983. Regulating and monitoring the fishery are the responsibilities of the National Marine Fisheries Service (NMFS). The Fishery Management Research Program (FMRP) of the Honolulu Laboratory, Southwest Fisheries Science Center, NMFS, NOAA, collects technical information for analyses from vessels permitted to fish exclusively in the Northwestern Hawaiian Islands (NWHI) for 1990. Permits were not issued for any other areas.

In addition to the FMRP, other NMFS agencies contributed to this report: The Insular Resources Investigation of the Honolulu Laboratory provided a summary of the biological research and assessment on the fishery (Polovina 1991) and Alvin Z. Katekaru of the Southwest Region, Pacific Area Office, and Victor A. Honda of Southwest Enforcement prepared the information on administrative activities and enforcement. Robert F. Harman of the WPRFMC's staff prepared information on WPRFMC-related activities.

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INTRODUCTION

The Northwestern Hawaiian Islands (NWHI), an isolated range of islands, islets, banks, and reefs, extends 1,500 nmi northwest, from Nihoa Island to Kure Atoll (Fig. 1). The commercial lobster fishery has operated in the NWHI for 12 years, and its main target species--spiny lobster, *Panulirus marginatus*, and common slipper lobster, *Scyllarides squammosus*, henceforth referred to as slipper lobster--dominate commercially. A third species--ridgeback slipper lobster, *S. haanii*--is caught incidentally; a fourth species--Chinese slipper lobster, *Parribacus antarcticus*--is not commercially attractive.

This report details commercial lobster fishing activity in the exclusive economic zone (EEZ) of the NWHI. Current catch, effort, and revenue statistics are based on logbook data and are constructed for the main target species in tabular format, along with brief summaries. Evaluations of the biological and economic conditions of the fishery also are provided. This report concludes with separate sections on administrative and enforcement activities in the fishery.

RECENT DEVELOPMENTS

The most predominant developments of the fishery for 1990 are the reduced catches, the dramatic increase in ex-vessel prices for spiny lobster, the decrease in catch per unit effort (CPUE; the number of legal lobsters per trap-haul), and the intensive increase in total fishing effort despite lower CPUE.

After 2 years of stability, landings and revenue declined in 1990. The total number of pounds landed fell to its lowest level since 1987 (Fig. 2), and CPUE was the lowest in history of the fishery (Fig. 3). Bank production for 1990 and yearly CPUE significantly declined at Maro Reef, whereas relative production at Gardner Pinnacles and Necker Island increased.

The decreasing tail size of spiny lobster (a lingering problem and a possible product of overfishing) continued to be a prime concern of vessel operators, with the majority of the product landed in the 4-8 oz tail range. With heavy effort over the last 2 years, the fishery is showing strain, and the Western Pacific Regional Fishery Management Council (WPRFMC) has proposed regulations to protect the future health of the fishery by closing the NWHI for significant periods until July 1992.

Fishing effort in trap-hauls is now at just over 1 million, second only to peak effort in 1986 and over 10% higher than in 1989 (Fig. 4). Fishing effort in number of trips and vessels

continued its recent growth trend. However, seven lobster vessels converted (on a part-time basis) from lobster fishing to longlining for tuna (e.g., *Thunnus* spp.) or broadbill swordfish, *Xiphias gladius*, at the end of 1990, and another converted to bottomfish fishing in the NWHI. However, most vessels are waiting to see whether the season will be open for a sufficient length of time before they resume lobster fishing in 1991.

Total industry ex-vessel revenue fell 22% from 1989 to 1990 (Fig. 5), despite a 44% increase in the average price of frozen spiny lobster tails during the past 2 years to just over $15/lb (tail weight) (Fig. 6). Slipper lobster prices also increased since 1989. Wholesalers reported strong demand for spiny lobster tails and moderate demand for slipper lobster throughout 1990. Prices for spiny lobster tails were lower at the beginning of the year and rose throughout the summer to over $15.50/lb for spiny lobster tails in late fall and winter. Fishermen continued to target spiny lobster because of the high price and caught slipper lobster only incidentally, continuing a trend set in the 1986 season. Catch composition is described in Figure 7.

LANDINGS AND REVENUE

In 1990, total landings of lobster equaled 949,000 lb or 431 metric tons (t) (wet weight), and ex-vessel revenue was $4.9 million (Table 1). Fourteen vessels landed lobster from 45 trips, a 36% increase in trips over 1989. Broken down by predominant product type or species targeted, the NWHI fleet landed 356 t of spiny lobster and 75 t of slipper lobster (Table 2): a 38% and 19% reduction in catches, respectively. The 1990 catches of spiny lobster resemble those in 1981, but because of the price increase in tails, 1990 revenue resembles 1985 levels. [Tables 1 and 2 contain revisions from Clarke et al. (1988), Clark (1989), and Landgraf et al. (1990).] Estimated landings, ex-vessel prices, and ex-vessel revenue by product type are in Table 3.

FISHING EFFORT

Fishing effort for 1990 was the second highest on record, surpassing the third highest year, 1989, by 10.4%, from 1.07 million to 1.18 million (Table 1). Fishermen reported a total of 1,468 fishing days in 1990 (Table 4) compared to 1,323 in 1989 (Table 5). The increase is because of the entry of three vessels into the fishery: One class I vessel fished only half the year and participated in other fisheries the other half; one class II vessel fished three-quarters of the season; and one class III

vessel fishing for the entire year (Table 6).[1] The average number of trap-hauls per reported fishing day for 1990 was 806, close to the 1989 average of 810. This slight decrease was primarily due to the exit in 1989 of the class I-S vessel, the largest in the fleet. Effort was concentrated on three banks--Gardner Pinnacles, Necker Island, and Maro Reef (Table 4)--and was reflected in the landings by area (Table 7).

CPUE

The decline in legal CPUE is probably the most significant factor of the 1990 fishery. The number of combined legal lobsters caught per trap-haul was the lowest since monitoring of the fishery began. The lowest CPUE prior to 1990 was 1987 (0.92), but the fishery recovered in both 1988 (1.25) and 1989 (1.08) (Fig. 3); however, all are below the record effort year, 1986 (1.32). The combined CPUE for legal lobster fell to 0.66 in 1990, 0.50 for legal spiny lobster and 0.16 for legal slipper lobster (Table 4). This 37% plunge in combined CPUE is likely due to the high level of effort (4 million trap-hauls) since 1987, the majority of which is in the areas already intensely fished. Table 4 presents the CPUE figures by area for 1990.

The CPUE for all areas except Nihoa fell substantially in 1990 for legal spiny lobster. As a whole, CPUE for confidential areas (i.e., fishing areas that had few vessels, so data are pooled) dropped, but individually, the decline was more dramatic averaging 70% for each bank. Necker Island, the fishery leader, had a legal spiny lobster CPUE of 0.89 in 1988 and 0.95 in 1989 and led all banks with 0.54 in 1990. Gardner Pinnacles followed with a CPUE of 0.52, and Maro Reef was third with 0.41. Legal slipper lobster CPUE was highest for the other fishing areas at 0.55. Slipper lobster appeared to be a bycatch in 1990, with no real targeting. The total number of slipper lobster caught dropped 16%. Legal spiny and slipper lobster CPUE fell 43% and 23% from 1989. Total spiny lobster CPUE fell from 1.38 in 1989 to 1.05, and total slipper lobster CPUE was 0.26. For 1990 the monthly spiny lobster CPUE reached its highest point in April, was fairly steady through July, and tapered off the rest of the year (Fig. 8).

VESSEL OPERATIONS

Sea days analysis of the NWHI lobster fleet in 1990 is reported in unadjusted and adjusted modes (Table 8). Adjusted data annualize trip activity by deleting incomplete or

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[1]Vessels were categorized into size, activity, and class by Clarke and Pooley (1988): classes I and I-S are the largest vessels.

experimental trips and by taking vessel participation for part of a year and projecting it for the entire year. Based on these data, the number of fishing days per vessel was lower for class II and class III vessels for 1990 compared to 1989. Fishing days per vessel for classes I and I-S combined experienced a decline in 1990 with the departure of the only class I-S vessel in 1989. Adjusted fleet class configuration shows three class I, six class II, and four class III vessels active in 1990. One class I vessel that participated in the fishery is not included in the vessel operations figures because it conducted only one experimental trip with insignificant landings.

BIOLOGICAL ASSESSMENT

The CPUE was the lowest since the inception of the fishery in the late 1970s. Analyses of commercial logbooks and research conducted on the NOAA ship *Townsend Cromwell* provided the following conclusions (Polovina 1991):

(1) Low recruitment to the fishery was observed at Maro Reef and banks to the northwest, resulting in a decline in CPUE. Thus, most fishing effort was directed at Necker Island and Gardner Pinnacles, resulting in those populations being fished down.

(2) The spawning biomass index, based on CPUE, estimates that the 1990 level is 22% of the pre-fishery level. This is an indication that 1.2 million trap-hauls may have been excessive because of low fishery recruitment. It should be remembered that the 1990 spawning biomass is the lowest yet observed, and the recruitment to the fishery from the 1990 spawning biomass will not be observed until 1993.

(3) As of November 1990, there was no indication that recruitment at Maro Reef and other northwestern banks had improved.

(4) While a maximum sustainable yield (MSY) of 1 million lobsters with 1 million trap-hauls still appears appropriate, 1990 has shown that this is a long-term average, and considerable year-to-year variation can occur. To protect the population in poor years, management must be able to regulate annual catch or effort.

(5) Two actions were proposed to protect the current spawning biomass and promote the recovery of the annual CPUE to the 0.9-1.0 range in 1991: These actions include (a) closing the fishery from January through August to protect the spawning population both before and during the spawning period and (b) limiting annual fishing effort to 200,000 trap-hauls, which can be adjusted upward to 400,000 trap-

hauls if recruitment to the fishery at Maro Reef appears normal.

While the reasons for low recruitment to the banks in the northwestern portion of the archipelago are not known, there could have been an unusually strong movement of cold water from the northwest which transports lobster phyllosomes along the chain from west to east. This shift in larval abundance would appear as a drop in recruitment to the fishery 4 years later at Maro Reef and a corresponding increase in recruitment to the fishery at Necker Island.

RESEARCH

Biological Research

Mortality of spiny and slipper lobsters due to ghostfishing was examined in a number of tests by Parrish and Kazama (In review) in 1990. A string of eight unbaited, single-chamber plastic traps was deployed at 40-m (120-ft) depth off the island of Oahu, and monitored periodically by scuba during a 6-month period in 1990. The traps were stable and remained intact despite adverse oceanic conditions (strong currents and ground swell). The ability of lobsters to exit was tested in field and laboratory tests of traps stocked with Hawaiian spiny and slipper lobsters. Numerous entries and exits of lobsters were recorded. Both species exited similarly, with laboratory and field results indicating no significant difference in exit patterns. In all cases, lobsters exited within 23 days in a pattern of exponential decline. The data suggest that little direct mortality of lobster is due to an inability of the two species of lobster to exit traps; consequently, ghostfishing by these black plastic traps is not considered a problem for slipper and spiny lobsters (Parrish and Kazama In review).

Over a 3-year period, the Insular Resources Investigation of the Honolulu Laboratory conducted systematic trawl surveys around the Hawaiian Archipelago, collecting lobster phyllosomes via the *Townsend Cromwell*. Surrounding waters of Oahu, Necker Island, Maro Reef, Lisianski Island, and Midway Island have been examined out to 120 nmi north and south of each bank's 100-fm contour to record the abundance and distribution of larvae. Sea-surface current movements are presently being monitored through a series of satellite drift buoys deployed by the *Townsend Cromwell* in the waters around Necker Island and Maro Reef. Seasonal changes in abundance and distribution of larvae will continue to be explored with a similar follow-up trawl survey scheduled for September 1991 (F. Parrish, pers. commun., January 1991).

Economic Analysis

Economic performance in the NWHI lobster fishery in 1990 was relatively poor, particularly in light of the substantial increase in ex-vessel prices for lobsters. Table 9 provides a breakdown of vessel costs for an unweighted average of the three vessel classes (Clarke and Pooley 1988). Estimated fleet-wide net revenue (gross revenue less all expenses) was -$0.2 million, and fleet-wide total income (net revenue plus labor income) was only $1.1 million, the lowest estimate in 5 years (Table 10). Some vessels continued to do well, but the overall industry-wide impact of declining catch rates was clear.

ENDANGERED AND THREATENED SPECIES INTERACTIONS

Interactions with endangered and threatened species were observed over a wide range by lobster fishermen but not to the extent observed by longliners. All observations appear to be incidental and nonthreatening (Table 11).

WPRFMC ACTIVITIES

The WPRFMC directed its staff and Crustacean Plan Monitoring Team to work with National Marine Fisheries Service (NMFS) in developing an amendment to define recruitment overfishing for the NWHI lobster stocks in accordance with revised guidelines for National Standards 1 and 2 of the Magnuson Fishery Conservation and Management Act. The WPRFMC submitted amendment 6 to NMFS in September 1990, and the Secretary of Commerce approved it in February 1991.

In response to concerns voiced by fishermen that CPUE and average tail size of NWHI lobsters were decreasing, the WPRFMC began examining the need for further management action to protect the fishery. The WPRFMC fielded a mail survey of all lobster boat owners and captains to see whether the industry perceived a need for management action restricting entry to the fishery, limiting participant fishing activity, or both measures. Nearly all of the respondents believed that some form of restrictions was needed. In addition, the NMFS provided information on trends in tail sizes, as well as results of a summer research cruise to the NWHI. The research results indicated that a recruitment failure had occurred on at least one of the fishing banks (Maro Reef) and that fishing effort had increased accordingly at the other banks (especially at Necker Island). All of this information indicated that the condition of the NWHI lobster stock was deteriorating and immediate action was needed to protect it.

The fishing industry, WPRFMC staff, Crustacean Plan Monitoring Team, Crustacean Advisory Panel, and NMFS staff met

several times to begin developing recommendations for methods to manage the fishery. The Crustacean Plan Monitoring Team's recommendations, and an industry response to them, were presented to the WPRFMC and its Scientific and Statistical Committee in February 1991. The WPRFMC voted to recommend an emergency closure of the fishery in 1991, which would be in effect for 90 days and could be extended, if necessary, for another 90 days. During this closure, the WPRFMC and NMFS would work to develop a plan to limit entry and reduce fishing activity in the NWHI. The WPRFMC approved several elements of the plan, including limiting the fleet to 15 vessels and imposing a fleet-wide catch quota and an annual closed season from 1 January through 30 June.

ADMINISTRATIVE ACTIVITIES

The Southwest Region, Pacific Area Office, NMFS, issued 22 permits for commercial lobster fishing in the WPRFMC's Western Pacific Region during 1990. All of the permits issued were for area 1, the NWHI EEZ. Two permits were issued to new entrants to the fishery; five previously permitted vessels dropped out of the fishery. No permit applications were received for area 2 (main Hawaiian Islands) nor permit area 3 (American Samoa and Guam).

The carrying capacity of the 14 active vessels as reported on the permits was 15,380 traps, a net increase of 2,998 (24%) over the previous year. The average carrying capacity of active vessels in 1990 was 1,099 traps (Table 12).

ENFORCEMENT ACTIVITIES AND VIOLATIONS

On 27 occasions in 1990, NMFS Southwest Enforcement agents inspected returning lobster vessels that off-loaded their catches in Honolulu. Agents are aware of one landing of lobster other than in Honolulu. One violation requiring formal documentation was observed; it involved lobster fishing without a permit and failure to notify officials 24 hours before arrival.

The 1991 goal for NMFS Southwest Enforcement is to have complete coverage of returning lobster vessels, even though compliance by vessel captains and owners of existing regulations in this highly regulated fishery appears adequate. Enforcement coverage of returning vessels more than doubled 1989 inspections.

The high price and low catch rates have produced reports to Southwest Enforcement that some vessels are stripping eggs from the female lobsters. These allegations are being investigated.

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Table 1.--Annual landings (number and pounds), ex-vessel revenues (US$), fishing effort (trap-hauls, vessels, and trips), catch per unit effort (CPUE; number of legal lobster per trap-haul), and prices (US$/lobster) of slipper and spiny lobsters from the Northwestern Hawaiian Islands, 1977-90. Data are from vessel logbooks and revenue reports.

Year	Landings		Revenue ($)	Trap-haul (No.)	Vessels (No.)	Trips (No.)	Combined legal CPUE[b]	Price/lobster
	No.	Pounds[a]						
1977	--	72,000	209,000	--	5	14	--	--
1978	--	45,000	135,000	--	2	12	--	--
1979	--	100,000	320,000	--	2	6	--	--
1980	--	328,000	1,114,000	--	3	12	--	--
1981	--	780,000	2,730,000	--	10	25	--	--
1982	148,214	187,000	673,000	47,738[c]	7	19	3.10	4.54
1983[d]	234,700	203,000	591,000	84,870	4	19	2.77	2.52
1984	872,400	1,017,000	2,624,000	363,000	11	38	2.40	3.01
1985	1,812,700	2,368,000	5,887,000	983,062	16	62	1.80	3.21
1986	1,787,400	2,202,000	3,982,000	1,352,580	16	60	1.32	3.35
1987	737,800	969,000	3,988,000	804,723	11	38	0.92	5.41
1988	1,057,600	1,405,000	5,000,000	845,200	9	28	1.25	4.73
1989	1,160,253	1,470,000	6,291,000	1,071,538	11	33	1.08	5.42
1990	774,336	949,000	4,887,000	1,182,485	14	45	0.66	6.31

[a]Includes the weight of frozen lobster tails expanded to represent whole weight (spiny lobster tail weight = 35.6% of whole weight; slipper lobster tail weight = 33.3% of whole weight).
[b]Legal CPUE for slipper lobster before 1988 is calculated as 0.72 multiplied by the number of retained slipper lobster.
[c]Estimate is from Clarke and Yoshimoto (1990).
[d]The 1983 annual values were estimated from logbook returns from the latter 9 months of the year.

Table 2.--Estimated landings, ex-vessel prices (US$/lb), and ex-vessel revenues (US$) of spiny and slipper lobsters landed from the Northwestern Hawaiian Islands, 1977-90. Data are from vessel logbooks and revenue reports.

	Spiny lobster				Slipper lobster			
Year	Pounds[a]	Metric tons	Price ($/lb)	Revenue ($)	Pounds[b]	Metric tons	Price ($/lb)	Revenue ($)
1977	72,000	30	2.90	209,000	--	--	--	--
1978	45,000	20	3.00	135,000	--	--	--	--
1979	100,000	50	3.20	320,000	--	--	--	--
1980	328,000	150	3.40	1,115,000	--	--	--	--
1981	780,000	350	3.50	2,730,000	--	--	--	--
1982	187,000	80	3.60	673,000	--	--	--	--
1983	203,000	90	2.91	591,000	--	--	--	--
1984	935,000	425	2.66	2,490,000	82,000	37	1.63	134,000
1985	1,438,000	654	2.94	4,227,000	930,000	423	1.78	1,660,000
1986	1,149,000	521	3.23	3,710,000	1,053,000	479	2.16	2,272,000
1987	530,000	241	4.67	2,479,000	439,000	200	3.44	1,509,000
1988	1,218,000	553	3.66	4,453,000	186,000	85	3.12	581,000
1989	1,266,000	576	4.44	5,624,000	203,000	93	3.28	667,000
1990	784,000	356	5.51	4,319,000	165,000	75	3.43	567,000

[a]Includes frozen lobster tails expanded to represent whole weight (tail weight = 35.6% of whole weight).

[b]Includes frozen lobster tails expanded to represent whole weight (tail weight = 33.3% of whole weight).

Table 3.--Estimated landings, ex-vessel price (US$/1b), and ex-vessel revenue (US$), by product type, from the Northwestern Hawaiian Islands, 1977-90. Data are from vessel logbook and revenue reports.

			Spiny lobster				Slipper lobster				
Year	Product	Type	Pounds	Metric tons	Price ($)	Revenue ($)	Pounds	Metric tons	Price ($)	Revenue ($)	Vessels (No.)	Trips (No.)
1977	Live		72,000	33	2.90	208,000	--	--	--	--	5	14
1978	Live		45,000	20	3.00	135,000	--	--	--	--	2	12
1979	Live		100,000	45	3.20	320,000	--	--	--		2	6
1980	--		--	--	--	--	--	--	--	--	--	--
1981	--		--	--	--	--	--	--	--	--	--	--
1982	--		--	--	--	--	--	--	--	--	--	--
1983[a]	Live		25,000	11	4.46	111,600	--	--	--	--	4	12
	Frozen	Whole	15	0	4.00	60	--	--	--	--	1	1
	Frozen	Tails	51,400	23	7.41	380,800	--	--	--	--	2	7
1984	Live		36,500	17	4.70	171,700	--	--	--	--	7	9
	Frozen	Whole	3,500	2	3.98	13,800	100	--[b]	3.00	400	3	6
	Frozen	Tails	318,600	145	7.23	2,304,500	27,300	12	4.94	134,000	10	31
1985	Live		35,200	16	4.71	165,800	30	--[b]	3.90	100	7	21
	Frozen	Whole	2,800	1	4.08	12,800	600	--[b]	2.73	1,600	3	8
	Frozen	Tails	498,000	226	8.13	4,050,000	310,000	141	5.35	1,660,000	15	56
1986	Live		8,200	8	5.10	92,880	100	--[b]	5.25	600	6	16
	Frozen	Whole	15,500	7	3.84	59,500	3,600	2	2.45	8,700	6	9
	Frozen	Tails	397,000	180	8.96	3,558,000	350,000	159	6.47	2,263,000	16	56

Table 3.--Continued.

Year	Product	Type	Spiny lobster Pounds	Spiny lobster Metric tons	Spiny lobster Price ($)	Spiny lobster Revenue ($)	Slipper lobster Pounds	Slipper lobster Metric tons	Slipper lobster Price ($)	Slipper lobster Revenue ($)	Slipper lobster Vessels (No.)	Slipper lobster Trips (No.)
1987	Live		12,400	6	6.50	80,900	5,500	3	7.29	40,400	3	9
	Frozen	Whole	800	--[b]	5.78	4,600	1,800	1	3.96	7,100	3	3
	Frozen	Tails	183,200	83	13.00	2,383,000	143,000	65	10.16	1,452,000	10	37
1988[c]	Live		6,000	3	7.51	44,900	4,400	2	7.64	34,100	4	8
	Frozen	Whole	1,400	--[b]	4.00	5,500	--	--	--	--	3	3
	Live	Tails	431,000	196	10.24	4,402,200	60,500	28	9.04	547,000	9	28
1989	Live		24,000	11	7.62	188,300	14,500	7	7.03	102,000	4	9
	Frozen	Whole	2,200	1	5.00	11,100	--	--	--	--	--	--
	Frozen	Tails	441,300	200	12.29	5,424,600	62,900	29	8.98	565,000	11	33
1990	Live		57,900	26	7.27	421,300	6,000	3	6.66	41,000	6	16
	Frozen	Whole	500	--[b]	8.00	4,000	--	--	--	--	--	--
	Frozen	Tail	258,300	117	15.07	3,894,000	53,200	24	9.94	526,800	14	43

[a]April through December 1983.
[b]Less than 1 metric ton landed.
[c]Revised from 1987 annual report.

Table 4.--Annual fishing effort (days fished and trap-hauls) and catch per unit effort (CPUE; number of lobster per trap-haul) for spiny and slipper lobsters in the Northwestern Hawaiian Islands, 1990. Data are from vessel logbooks and revenue reports.

Area	Days fished (No.)	Trap-hauls (No.)	Catch per unit effort							
			Spiny lobster				Slipper lobster			
			Legal	Sublegal	Berried	Total	Legal	Sublegal	Berried	Total
Nihoa	15	5,450	0.20	0.01	0.17	0.38	0.16	0.02	0.02	0.26
Necker	592	425,406	0.54	0.63	0.17	1.35	0.12	0.02	0.02	0.17
French Frigate Shoals	11	6,882	0.17	0.23	0.16	0.56	0.41	0.13	0.37	0.91
St.Rogatien	9	3,370	0.12	0.04	0.02	0.18	0.13	0.03	0.01	0.18
Gardner Pinnacles	558	492,019	0.52	0.35	0.19	1.06	0.08	0.03	0.02	0.13
Maro Reef	237	211,186	0.41	0.10	0.06	0.57	0.31	0.15	0.19	0.65
Other[a]	46	38,172	0.34	0.02	0.02	0.38	0.55	0.05	0.06	0.65
Total	1,468	1,182,485	0.50	0.39	0.15	1.05	0.16	0.05	0.06	0.26

[a]Includes Brooks Bank, Raita Bank, Northampton Seamount, Pioneer Bank, Lisianski Island, Pearl and Hermes Reef, Midway Island, and Kure Atoll.

Table 5.--Annual fishing effort in number of vessels and trips, number of reported fishing days, estimated annual adjusted fishing day, and trap-hauls for active vessels in the Hawaiian lobster fishery in 1982-90.

Year	Vessels (No.)	Trips (No.)	Total fishing days	Fishing days/ per vessel[a]	Trap-hauls
1982	7	19	--	--	47,738[b]
1983	4	19	279	--	84,870
1984	11	38	822	--	363,000
1985	16	62	1,653	--	983,062
1986	16	80	2,166	--	1,352,580
1987	11	38	1,217	120	804,723
1988	9	28	1,617	139	845,200
1989	11	33	1,323	120	1,071,538
1990	14	45	1,468	109	1,182,485

[a]Unadjusted annualized fishing days for total fleet configuration are from Table 8.
[b]Estimated from Clarke and Yoshimoto (1990).

Table 6.--Entry and exit patterns of individual lobster fishing vessels in the Northwestern Hawaiian Islands, 1983-90. Vessels are coded for purposes of confidentiality. Xs indicate fishing in a particular quarter; ellipses indicate vessels that changed class. Data are from vessel logbooks.

Vessel code	1983				1984				1985				1986				1987				1988				1989				1990			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Class I-S																																
U																							X	X	X	X	X					
Class I																																
A					X	X	X	X	X	X	X	X																				
C								X	X	X	X	X	X	X	X	X											X	X	X	X	X	X
CC								X	X	X	X	X	X	X	X	X															X	X
N											X	X																				
V												X	X	X	X	X																
E													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
W														X																		
X														X	X	X	X															
AA														X	X	X																
J																		X	X	X										X	X	
Class II																																
S	X	X	X	X	X	X	X	X	X	X	X	X																				
F	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X		X	X	X
D								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X
Z																		X	X	X	X	X	X	X								
O																							X	X	X	X	X	X	X	X	X	X
K																										X			X	X	X	X
T																							X	X	X	X	X			X	X	X
FF																																

Table 6.--Continued.

Vessel code	1983				1984				1985				1986				1987				1988				1989				1990			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Class III																																
R	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
L	X					X																										
BB					X																											
B							X																									
I							X		X	X	X	X	X	X	X	X	X	X	X	X	X	X										
M								X	X	X	X	X	X	X	X	X																
P								X	X	X	X	X	X																			
Y									X								X	X														
EE									X	X	X	X	X	X	X	X																
G										X																						
DD											X	X					X	X	X	X	X	.	.	.	.	.	.	.				
O													X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	
Q																									X	X	X	X	X	X	X	
H																													X	X	X	
GG																																

Table 7.--Annual fishing effort (vessel and trips) and catch (number) of spiny and slipper lobsters, by area, in the Northwestern Hawaiian Islands, 1990. Data are from vessel logbooks and revenue reports.

Area	Vessels (No.)	Trips (No.)	Catch (No.)							
			Spiny lobster				Slipper lobster			
			Legal	Sublegal	Berried	Total	Legal	Sublegal	Berried	Total
Nihoa	3	5	1,071	74	916	2,061	870	94	428	1,392
Necker Island	12	29	231,278	268,754	73,168	573,200	52,306	9,348	8,690	70,344
French Frigate Shoals	4	5	1,179	1,584	1,098	3,863	2,811	893	2,567	6,271
St. Rogatien Bank	5	6	390	149	59	598	455	117	46	608
Gardner Pinnacles	10	21	256,633	172,857	92,645	522,135	40,284	12,931	11,192	64,407
Maro Reef	7	11	87,025	20,073	12,411	119,509	66,079	30,763	41,056	137,898
Other[a]	11	12	13,092	927	923	14,942	20,873	1,743	3,220	25,836
Total	14	45	590,688	464,418	181,220	1,236,306	183,668	55,889	67,199	306,756

[a]Includes Brooks Bank, Rita Bank, Northhampton Bank, Lisianski Island, Pioneer Bank, Pearl and Hermes Reef, Midway Island, and Kure Atoll.

Table 8.--Annualized mean number of vessels, trips, and sea days, by vessel class, for the lobster fleet in the Northwestern Hawaiian Islands, 1990. Unadjusted figures include incomplete trips; adjusted figures are on an annualized basis. Standard deviations are in parentheses; data are from vessel logbooks.

Vessels		Trips	Sea	Mean number of sea days by activity						
Class	No.	(No.)	days	Fishing	Traveling	Running	Weather	Breakdown	Rest/deck work	Missing
Unadjusted										
I	3	9	145.0 (59.2)	109.0 (59.2)	5.7 (0.6)	20.0 (7.8)	6.0 (7.9)	0.7 (2.1)	1.7 (2.1)	2.0 (0.0)
II	6	20	167.0 (24.1)	125.5 (24.1)	4.7 (5.0)	23.3 (5.8)	6.8 (8.6)	3.0 (4.2)	1.2 (0.8)	2.5 (1.8)
III	4	14	116.0 (10.5)	84.3 (10.5)	2.8 (1.9)	22.5 (2.9)	3.0 (4.8)	2.3 (1.5)	0.5 (0.6)	0.8 (1.0)
Total fleet	13	43	146.2 (37.1)	109.0 (28.9)	4.3 (3.6)	22.3 (5.3)	5.5 (7.1)	2.2 (3.0)	1.1 (1.1)	1.8 (1.5)
Adjusted										
I	3	12	189.7 (38.2)	143.0 (38.2)	8.3 (3.2)	26.3 (5.1)	6.3 (7.8)	1.0 (1.0)	1.7 (2.1)	3.0 (1.0)
II	6	23	197.3 (35.7)	149.3 (35.7)	5.3 (5.6)	27.2 (5.2)	8.0(11.2)	3.2 (4.3)	1.5 (0.8)	2.8 (1.6)
III	4	19	154.5 (14.0)	112.0 (14.0)	3.8 (2.6)	30.0 (4.2)	4.3 (6.7)	2.8 (2.1)	0.5 (0.6)	1.3 (1.5)
Total fleet	13	54	182.4 (34.8)	136.4 (32.0)	5.5 (4.4)	27.8 (4.7)	6.5 (8.7)	2.5 (3.1)	1.2 (1.2)	2.4 (1.6)

Table 9.--Income statement for the average lobster fishing vessel in the Northwestern Hawaiian Islands, 1990.[a] All three vessel classes are combined in an unweighted average of annualized production. (Columns may not sum because of rounding.)

Revenue ($)	403,001	
Fixed costs ($)	249,524	
Capital	96,080	
Annual repair	38,234	
Insurance	55,469	
Administrative	13,214	
Other	46,526	
Operating costs ($)	245,339	
Fuel and oil	46,381	
Bait	30,592	
Handling	18,321	
Provisions	16,981	
Supplies	4,340	
Gear	19,233	
Other	6,912	
Labor income	95,422	
Captain's bonus	7,157	
Total cost ($)	494,862	
Net revenue ($)	⟨91,861⟩	
Operating characteristics (unweighted average)		
Investment ($)	805,887	
Trips No.	4.2	
Catch (lb) per day	255	
Trip days (No.)	181	
Fishing days (No.)	135	
Crew share (%)	36.7	
Crew (No.)	6.67	
		Per trap-haul
Revenue ($)	403,001	$3.65
Product price ($) per pound	11.75	
Total catch (lb)	34,308	0.31
Traps hauled (No.)	110,282	819
Capital factor (%)	10.00	
Depreciation factor (%)	6.67	

[a]Data were compiled using 1986 baseline values updated to 1990 and adjusted for inflation and operating characteristics (see Clarke and Pooley (1988) for methodology).

Table 10.--Income estimate for the lobster fleet in the North western Hawaiian Islands, 1986-90. Values (in US$ millions) are estimated from annualized earnings per vessel class, adjusted to actual gross revenue.

	US$ (in millions)				
	1986	1987	1988	1989	1990
Gross revenue	6.0	4.0	5.0	6.3	4.9
Net revenue	-0.2	0.4	1.2	0.9	-0.2
Labor income	1.7	1.1	1.4	1.8	1.3
Total income	1.5	1.5	2.6	2.7	1.1

Table 11.--Reported sightings of or interactions with endangered or threatened species by the lobster fleet in the Northwestern Hawaiian Islands, 1990. Data are from the vessel logbooks.

Area	No. of sightings by No. of individuals	
	One individual	Two individuals
Monk seals observed in statistical area		
Gardner Pinnacles	10	
Kure Atoll	2	
Maro Reef	2	
Necker Island	23	1
Monk seals observed in vicinity of fishing gear		
Gardner Pinnacles	3	
Maro Reef	1	
Necker Island	5	
Turtles observed in statistical area		
Kure Atoll	1	
Maro Reef	4	
Necker Island	4	

Table 12.--Permit and vessel activity in the lobster fishery in the Northwestern Hawaiian Islands, 1983-90, as reported on the permit applications to the Southwest Region, National Marine Fisheries Service.

Year	Permits Issued (No.)	Trap (No.)	Carrying capacity of active vessels[a] (No. of traps)	
			Total	Average
1983	14	4	1,200	300
1984	19	11	5,240	476
1985	45	16	12,250	703
1986	54	16	13,580	849
1987	41	11	9,150	832
1988	26	9	9,420	1,047
1989	17	11	12,382	1,126
1990	22	14	15,380	1,099

[a]*Aleutian Spray*
Archer
Betty N
Bounty
Cornucopia
Dominis
Haida
Laysan
Liberty
Lusty
Marie M
Miss Jessico
Sea Spray
Shaman

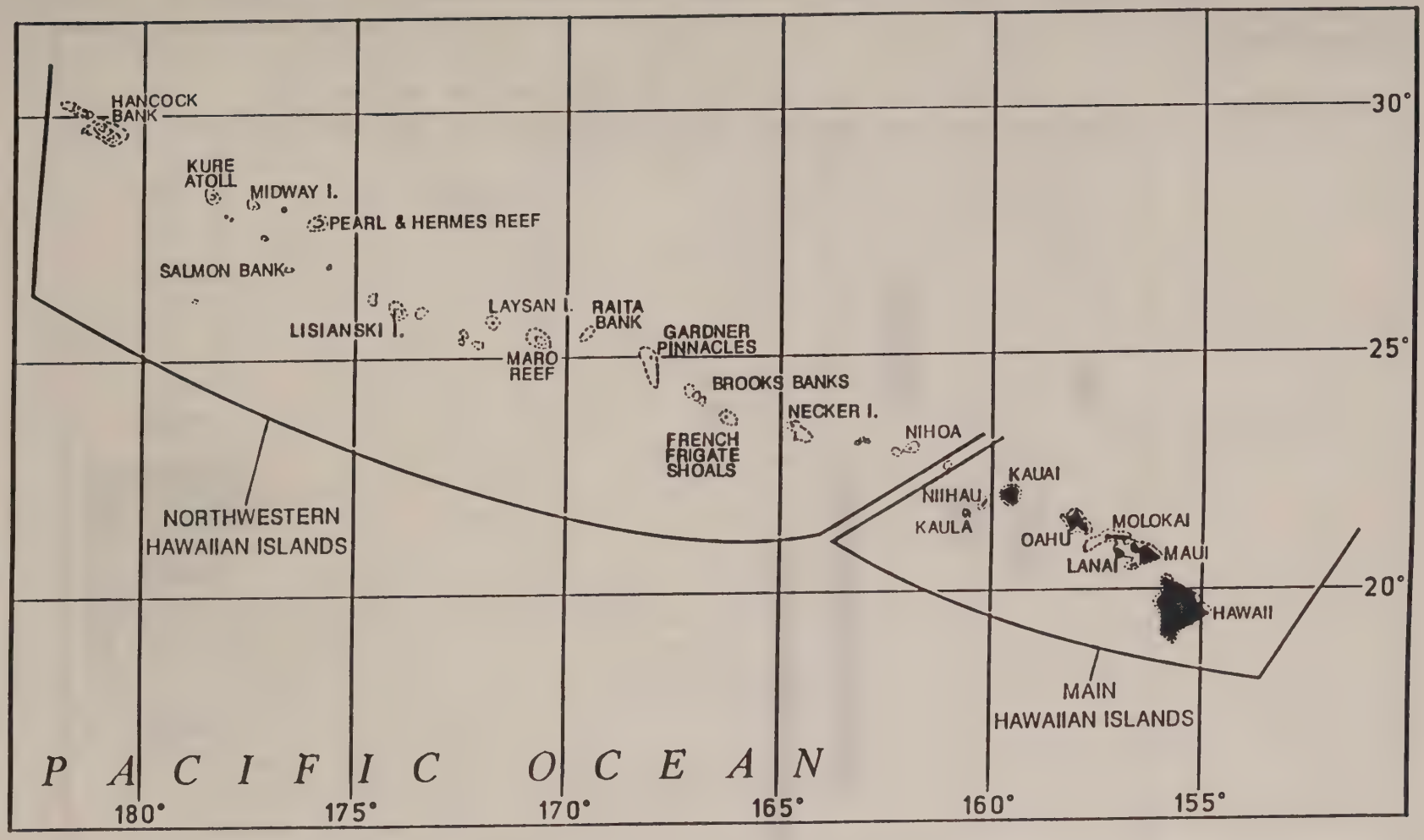


Figure 1.--Map of the Northwestern Hawaiian Islands (permit area 1) and the main Hawaiian Islands (permit area 2).

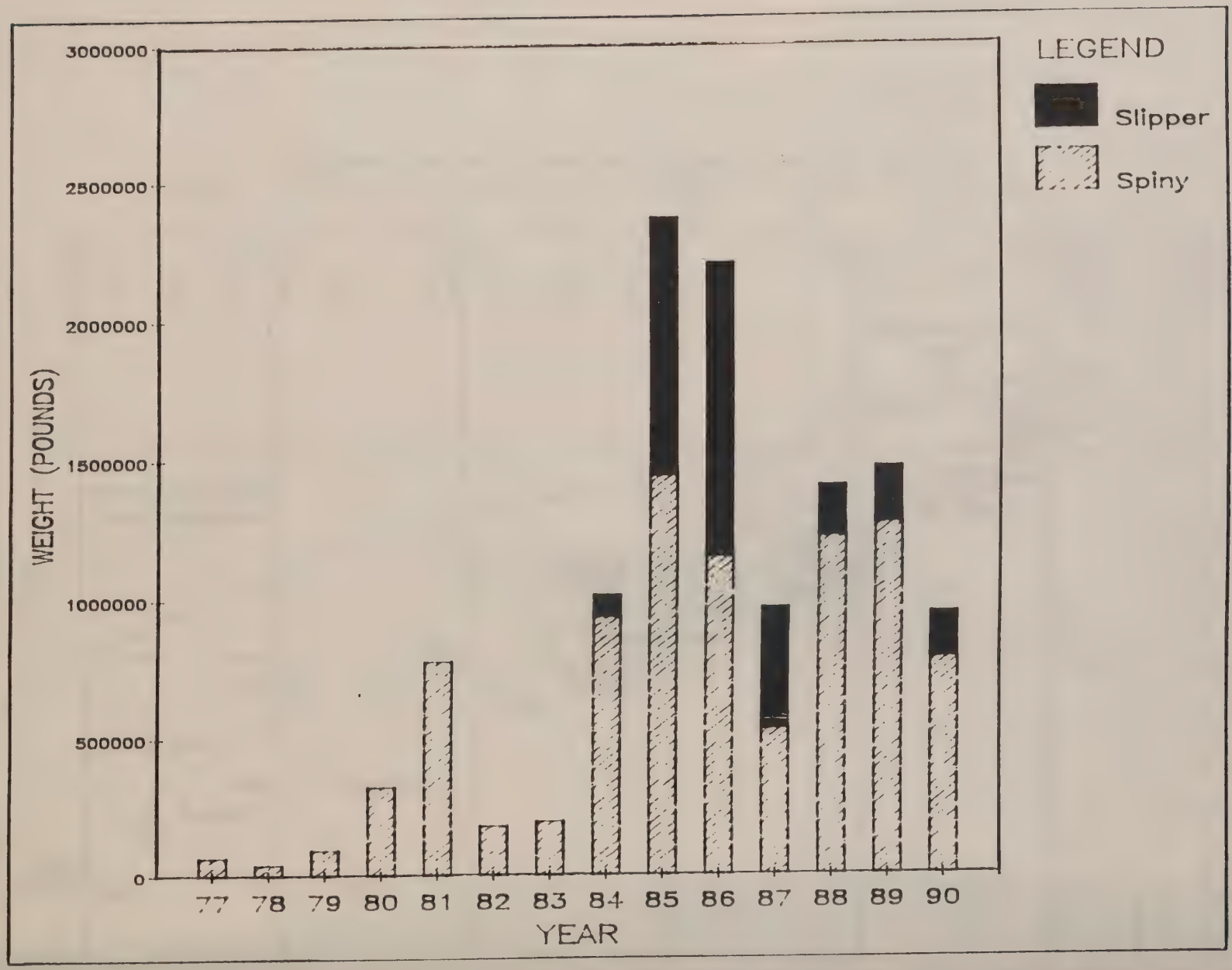


Figure 2.--Estimated annual landings (wet weight) of spiny and slipper lobsters in the Northwestern Hawaiian Islands, 1977-90.

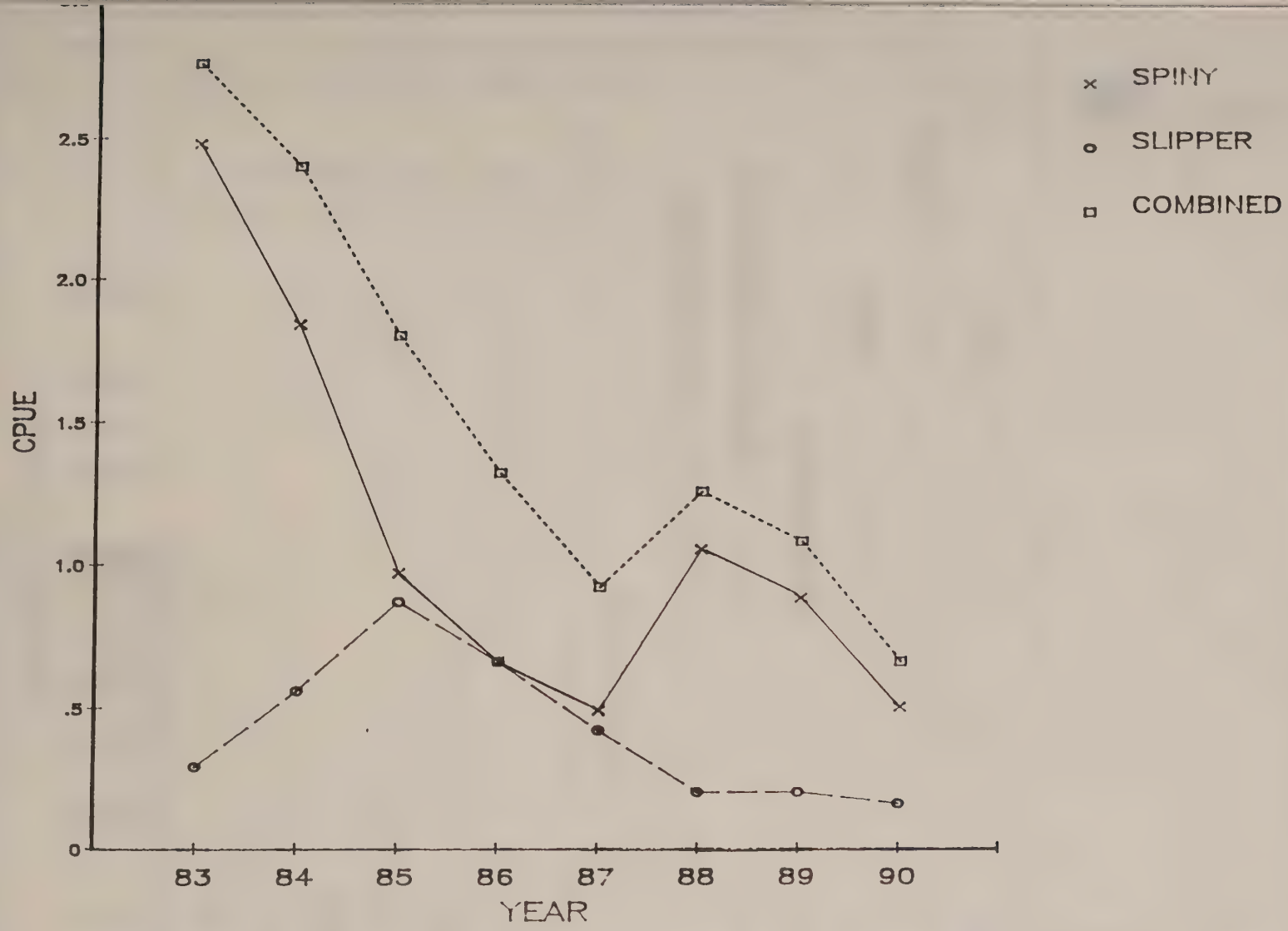


Figure 3.--Catch per unit effort (CPUE) for spiny and slipper lobsters from the Northwestern Hawaiian Islands, 1983-90. (CPUE for slipper lobster is calculated as 0.72 multiplied by the number retained before 1988.)

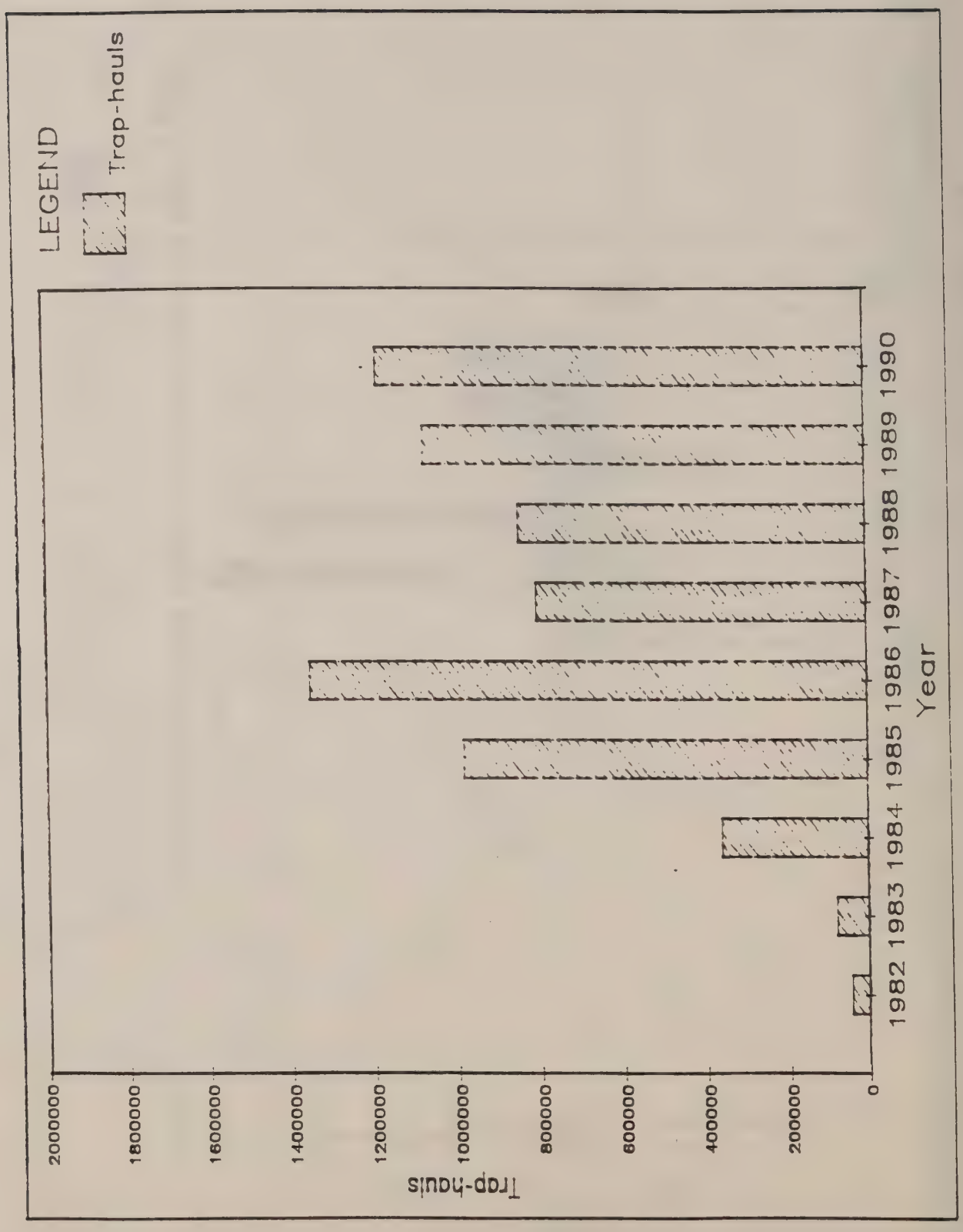


Figure 4.--Fishing effort (trap-hauls) by the lobster fleet in the Northwestern Hawaiian Islands, 1983-90.

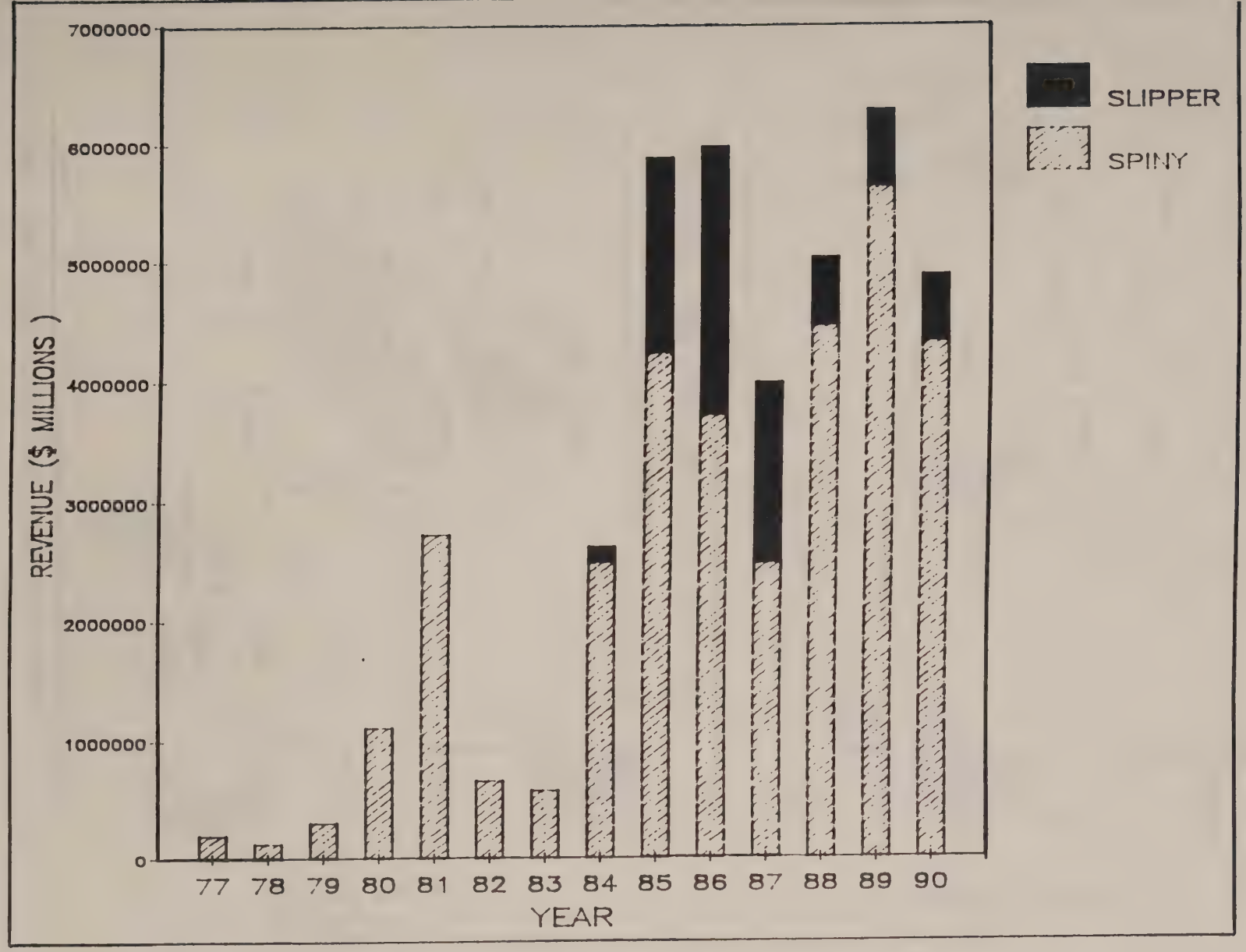


Figure 5.--Ex-vessel revenue for spiny and slipper lobsters from the Northwestern Hawaiian Islands, 1977-90.

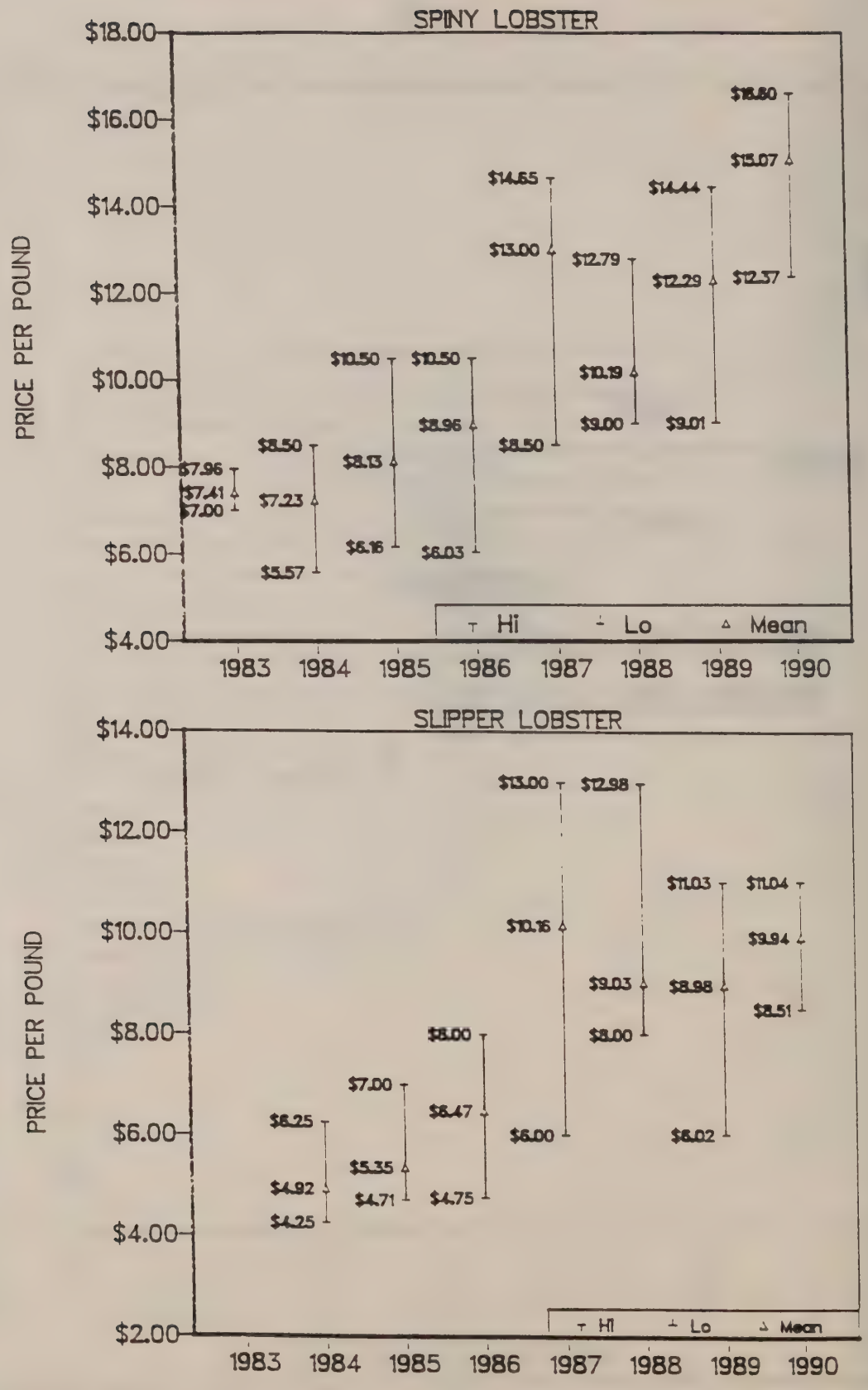


Figure 6.--Low, mean, and high ex-vessel prices of frozen spiny and slipper lobster tails from the Northwestern Hawaiian Islands, 1983-90.

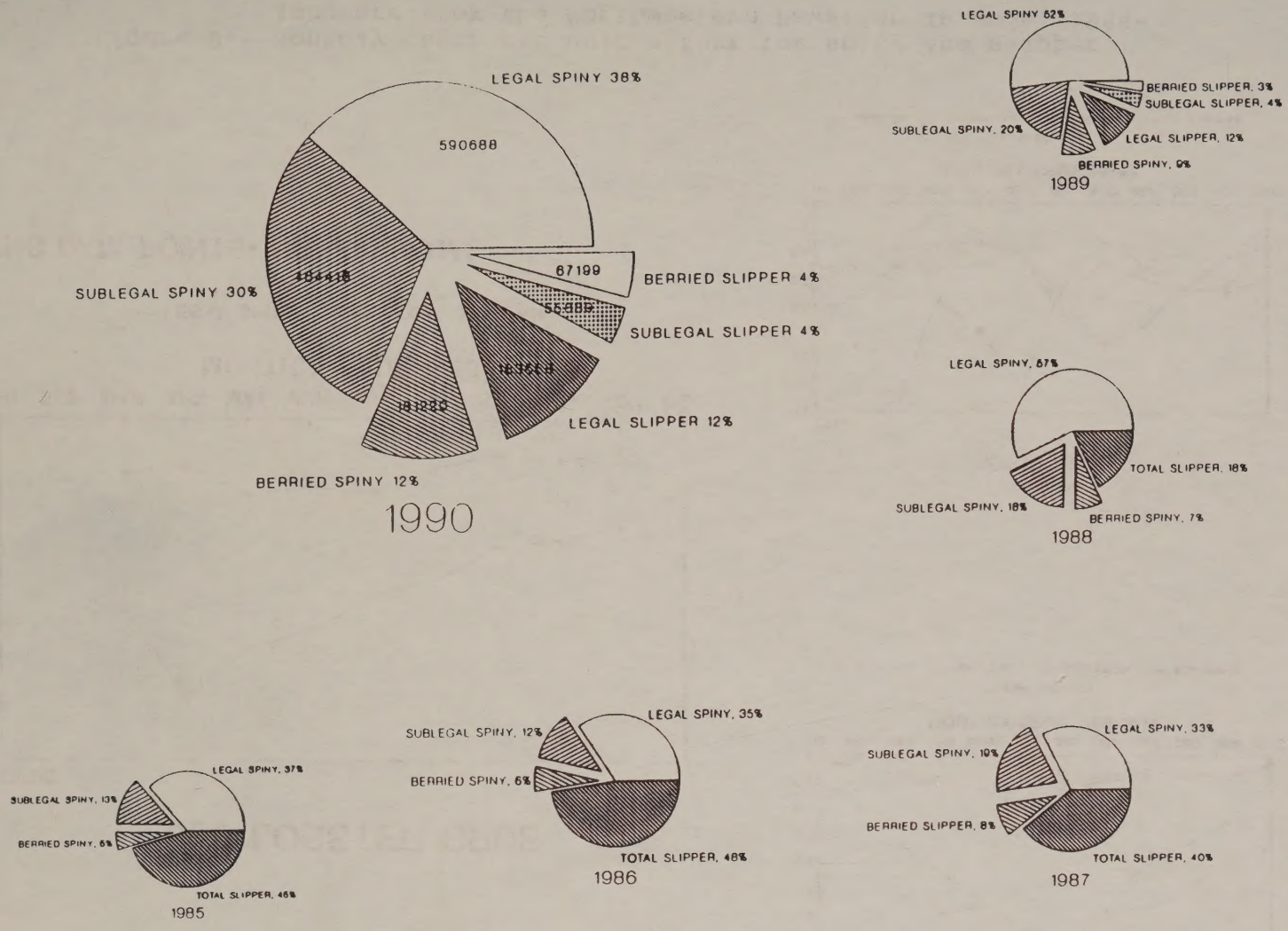
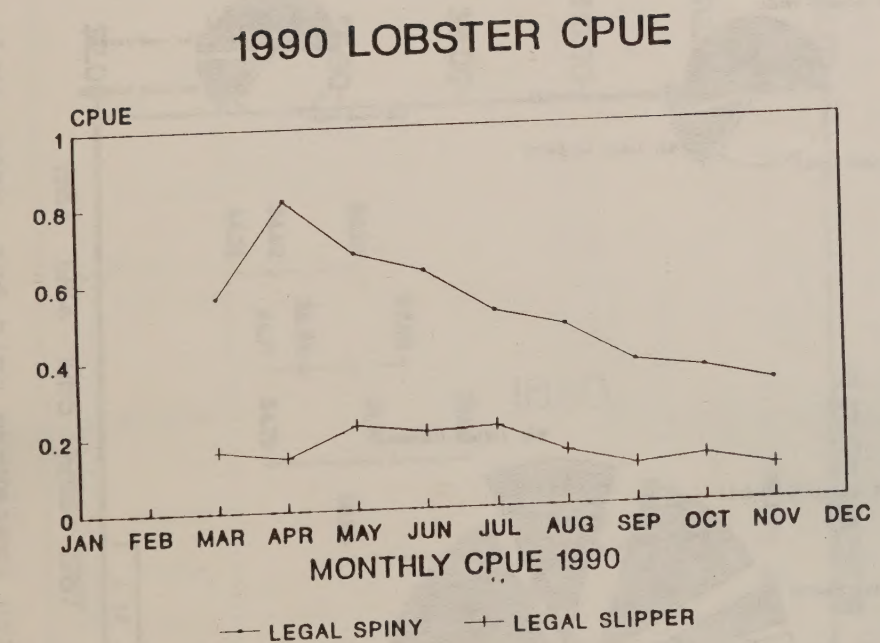
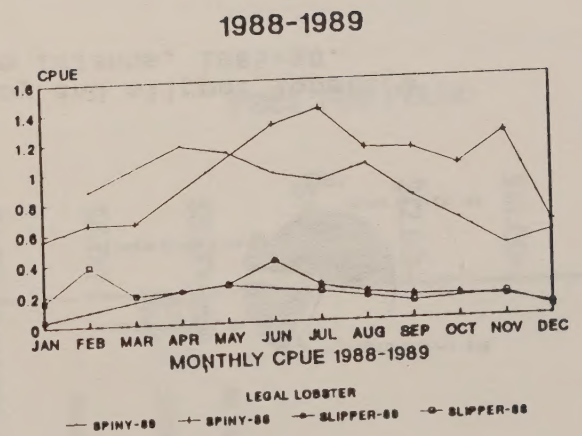


Figure 7.--Composition of catches of spiny and slipper lobsters from the Northwestern Hawaiian Islands, 1985-90.





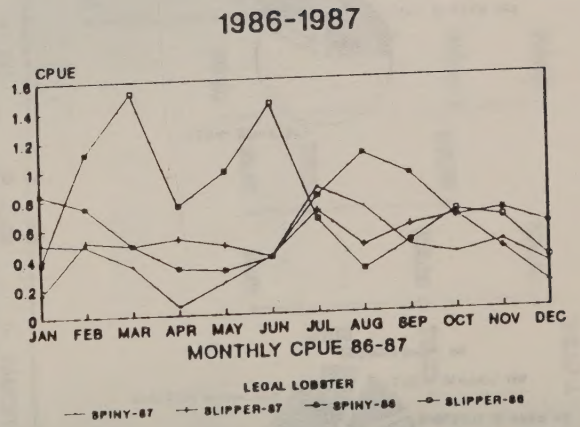


Figure 8.--Monthly catch per unit effort for spiny and slipper lobsters from the Northwestern Hawaiian Islands, 1986-90.